AlfioBorzì

Professor of Mathematics

This curriculum vitae documents the evolution of my academic career dedicated to advancing applied mathematics through research, education, scientific leadership, and interdisciplinary collaboration.

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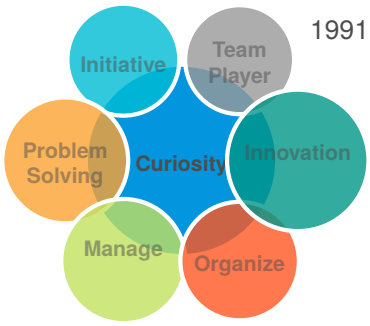
Web
Alfio Borzi
Chair of Scientific Computing

Personal Data
(prev. Alfio E. Borzì)
Birth: 01.03.1965,
Catania, Italy
Citizenship: Italian, German

Personal Skills



Experience

2011 - Now **Full Professor (Chair Mathematik IX)** University of Würzburg, Germany
Starting March 1st, 2011, till now, Full Professor (W3) and Chair of Mathematik IX 'Scientific Computing' at the Institute for Mathematics, University of Würzburg. I have built up this new chair to its present status including W1 and W2 professorships and, in few years, I could make this chair internationally visible to different scientific communities.
(In 2011, I also got a call for the full professorship 'Algorithmic Optimization' at the Humboldt Universität zu Berlin, but I declined this offer.)

2008 - 2011 **Associate Professor** Università degli Studi del Sannio, Italy
In the period 2008-2011 (on leave from Univ. Graz), I was Associate Professor at the Università degli Studi del Sannio in the Engineering School. During this period, I contributed to the LIGO project and collaborated on the development of algorithms for image restoration applied to SAR interferograms.

2003 - 2011 **Associate Professor** University of Graz, Austria
In the period 2003-2007, I was Associate Professor at Institute for Mathematics and Scientific Computing, Karl-Franzens-University Graz. During this period I was leading a FWF project on quantum control problems and a SFB sub-project on non-linear reaction-diffusion (monodomain) models for medical application.

1998 - 2003 **Assistant Professor** University of Graz, Austria
In 1998 - 2003, I was Assistant Professor at Institute for Mathematics and Scientific Computing Karl-Franzens-University Graz. My research focused on multigrid methods and optimal control problems.

1996 - 1997 **Research Engineer** AVL List GmbH, Graz, Austria.
During the period 1996 - 1997, I was Research Engineer in the internationally renowed company AVL List GmbH, Graz, Austria. I worked on CFD and gas dynamics problems in engine simulation, multigrid solvers, and finite-volume schemes. I have continued this activity as private contractor till 2008.

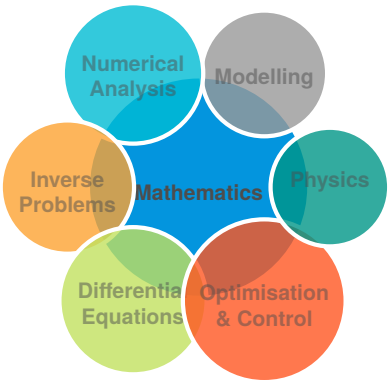
1993 - 1995 **Research Officer** University of Oxford, UK
In 1993 - 1995, I was Research Officer at the Oxford University, Oxford, UK, in the group of Professor Bill Morton. I worked on the analysis of finite-volume schemes and their solution by multigrid methods.

1991 - 1992 **Lieutenant** CNMCA, Roma, Italy
During the period 1991 - 1992, I was an Italian Air Force Officer (Lieutenant) serving at the Centro Nazionale di Meteorologia e Climatologia, CNMCA, Roma, Italy. I worked on data analysis, Kalman filters, and numerical weather prediction.

Languages

Italian ★★★★★
English ★★★★★
German ★★★★☆
French ★☆☆☆☆

Scientific Knowledge



Professional metrics

Scopus h-index : 25;
Google h-index : 35;
i10-index : 98;
Total citations : Scopus 2498; Google 4989.

OS & Coding

GNU/Linux ★★★★★
MacOS ★★★★★
Fortran ★★★★★
MATLAB ★★★★★
Python ★★★★★
C++ ★★★★★

Places Lived

Benevento
Cambridge
Catania
Firenze
Graz
Oxford
Roma
Salzburg
Würzburg

Education

1998 - 2003 **Habilitation** Karl-Franzens-University Graz
Habilitation at Karl-Franzens-University Graz, Austria.

1991 - 1993 **Dottore di ricerca in Matematica** SISSA/ISAS, Italy
Doctor Philosophy (Ph.D.) in Mathematical Physics, SISSA/ISAS-International School for Advanced Studies, Trieste, Italy.

1988 - 1990 **Magister Philosophiae (M.Ph.) in Mathematical Physics** SISSA/ISAS, Italy
1988 - 1990 Master Philosophy (M.Ph.) in Mathematics, SISSA/ISAS-International School for Advanced Studies, Trieste, Italy.

1983 - 1988 **Laurea in Fisica** Università degli Studi di Catania, Italy
1983 - 1988 Laurea in Physics (MSc), University of Catania, Italy.

Additional education

1997 **Entrepreneur Qualification (Unternehmer Prüfung)** WIFI Graz, Austria
Academy of Management, WIFI Graz (A).

1996 **Unix and Database Administrator** HP and Informix, Austria and Germany
Administration of UNIX systems, Hewlett-Packard, Boeblingen (D), Vienna (A). Development and administration of databases, Informix, Ismaning (D).

1991 **Meteorology and weather prediction** Lieutenant, Italian Air Force, Italy
Meteorology and numerical weather prediction, National Center of Meteorology and Climatology (CNMCA), Roma (I).

Main research and teaching topics

1) Numerical solution of PDE optimization problems. 2) Development and analysis of multigrid methods. 3) Analysis of discretization schemes for partial differential equations. 4) Uncertainty quantification in simulation and optimization. 5) Simulation and control of quantum systems. 6) Modelling and numerical solution of gas dynamics problems. 7) Modelling and simulation of bio-chemical processes. 8) Imaging analysis and inverse problems. 9) Multi-agent differential systems. 10) Stochastic models and related control problems. 11) Fokker-Planck models and related control problems. 12) Ensemble optimal control of kinetic models. 13) Analysis and numerical solution of differential games. 14) Machine learning and AI.

Research Work - Main Contributions

Trained in Mathematics and Physics, my main field of expertise consists in developing and combining analytical and numerical methods in view of modelling and solving fundamental application problems that are often related to modelling, simulation, optimal control and optimisation. I am among the early initiators and/or contributor to the following research fields

1. Multigrid methods for solving optimality systems

Reviewer

For Agencies:
DFG, ANVUR, The Royal Society of London, The Russian Science Foundation
For Journals:
SISC, SICON, SINUM, SIOPT, MMS, COAP, JCAM, JCOMP, JDCS, OMS, IJVC, NM:TMA, etc.

Scopus & ORCID

Scopus Author ID: 6603632708

ORCID ID: 0000-0002-8050-1336

2. Modelling and numerical solution of quantum control problems
3. Fokker-Planck approach to control and identification of stochastic models
4. Ensemble optimal control problems with kinetic models
5. PMP-based methods for solving nonsmooth optimal control problems

Among my achievements, I also would like to mention the modelling of leadership-based control of multi-agent systems and opinion-formation models, new schemes for solving medical imaging problems, modelling and control of fermentation dynamics, and various theoretical and numerical analysis results with linear and nonlinear PDE models.
Present research topics also include Monte Carlo methods to solve ensemble optimal control problems, modeling and analysis of differential games, superresolution microscopy, and optimal-control and preconditioned-gradient methods for machine learning. Reservoir computing.

Teaching

Analysis I and II, Linear Algebra I and II, Optimization I and II, Operations Research, Complex Analysis, Functional Analysis, Applied Analysis, Nonlinear Analysis, Theory of Ordinary Differential Equations, Programming in C++, Numerical Analysis I and II, Theory of Partial Differential Equations, Optimal Control Theory, Numerical Linear Algebra, Multigrid Methods, Multilevel Methods in Optimization with PDE models, Numerical Analysis of Partial Differential Equations and Optimality Systems, Modelling and Scientific Computing, Simulation and Optimal Control of Quantum and Stochastic Systems, Analysis and Implementation of Neural Networks, Kinetic Theory and Transport Problems.

I have been responsible to design and deliver series of PhD lectures on multilevel methods, optimization and control, and numerical analysis of PDEs for PhD schools in the Philippines (Diliman), The Netherlands (Woudschoten-Zeist), Italy (Catania, Roma, Cosenza), Austria (Graz), Spain (Zaragoza), and Germany (Schloss Thurnau and Trier).

Memberships and fellowships

- Member of GiP - Gesellschaft für Inverse Probleme e.V.
- Member of the Research Council of the Hugo Steinhaus Center, Wrocław (Breslau). `http://prac.im.pwr.wroc.pl/~hugo/HSC/hsc_ang.html`.
- Profesor Invitado of the PHD Program in Applied Mathematics at Escuela Politécnica National de Ecuador. `http://www.math.epn.edu.ec/doctorado/index.php/profesores`.
- Past member of EMS and SIAM.
- Tinsley Oden Fellow, Institute for Computational Engineering and Sciences, University of Texas at Austin, USA.

Professional responsibilities

- Member of the Internationalisation Committee , Universität Würzburg. Past Member of the Commission for Research and Technology Transfer of the University of Würzburg. Past member of the Research in Sciences Committee, Universität Würzburg.
- Chairman of the Hiring Committee ‘Prodi Chair’.
- Chairman of the Master Mathematics International.

- Chair Mathematik IX and co-administration of the Institute for Mathematics at JMU Würzburg.

Editor Duty

Associate Editor:
Book series: Advances in Mechanics and Mathematics, Birkhäuser
SIAM Review, Books section
SIAM Journal on Scientific Computing (SISC) - until 2020 -
Guest Editor of CVS, NLAA, NM:TMA, and Journal of Franklin Institute.

Supervision of PhD Thesis

- **S. Hofmann**, *The Pontryagin Maximum Principle and Defect Correction in Supervised Learning*, PhD Math. Thesis, Univ. Würzburg, 2025.
- **N. Vater**, *Preconditioned gradient methods for solving nonlinear underdetermined least-squares problems*, PhD Math. Thesis, Univ. Würzburg, 2024. *Gemeinsamen Promotionspreis der Unterfränkischen Gedenkjahrstiftung und der Universität Würzburg 2025.*
- **J. Körner**, *Theoretical and numerical analysis of Fokker-Planck optimal control problems by first- and second-order optimality conditions*, PhD Math. Thesis, Univ. Würzburg, 2024.
- **J. Bartsch**, *Theoretical and numerical investigation of optimal control problems governed by kinetic models*, PhD Math. Thesis, Univ. Würzburg, 2021.
- **F. Calà Campana**, *Numerical methods for solving open-loop non zero-sum differential Nash games*, PhD Math. Thesis, Univ. Würzburg, 2021.
- **T. Breitenbach**, *A sequential quadratic Hamiltonian scheme for solving optimal control problems with non-smooth cost functionals*, PhD Math. Thesis, Univ. Würzburg, 2019.
- **D. Kioi Gathungu**, *On multigrid and H-matrix methods for partial integro-differential equations*. PhD Math. Thesis, Univ. Würzburg, 2017.
- **M. Sprengel**, *A theoretical and numerical analysis of a Kohn-Sham equation and related control problems*, PhD Math. Thesis, Univ. Würzburg, 2017.
- **B. Gaviraghi**, *Theoretical and numerical analysis of Fokker-Planck optimal control problems for jump-diffusion processes*. PhD Math. Thesis, Univ. Würzburg, 2017.
- **A. Schindele**, *Proximal methods in medical image reconstruction and in nonsmooth optimal control of partial differential equations*. PhD Math. Thesis, Univ. Würzburg, 2016.
- **J. Merger**, *Optimal control and function identification in biological processes*. PhD Math. Thesis, Univ. Würzburg, 2016.
- **S. Wongkaew**, *On the control through leadership of multi-agent systems*. PhD Math. Thesis, Univ. Würzburg, 2015.
- **G. Ciaramella**, *Optimal control of quantum spin systems*. PhD Math. Thesis, Univ. Würzburg, 2015. *Gemeinsamen Promotionspreis der Unterfränkischen Gedenkjahrstiftung und der Universität Würzburg 2016.*
- **M. Mohammadi**, *Discretization of the Fokker-Planck equation and related control systems*. PhD Math. Thesis, Univ. Würzburg, 2015.
- **M. Munir Butt**, *Formulation and multigrid solution of Cauchy-Riemann optimal control problems*, PhD Math. Thesis, Univ. Graz, 2011.

- **M. Vallejos**, *Multigrid optimization methods for elliptic optimal control problems*. PhD Math. Thesis, Univ. Graz, 2008.

Ongoing:

- **K. Bernreuther**, *Norm- and time-optimal control problems governed by infinite-dimensional dynamical systems*, PhD Math. Thesis, ongoing.
- **V. Hock**, *Theoretical and numerical analysis of machine-learning and multigrid methods for optimization and simulation problems with the Helmholtz equation*, PhD Math. Thesis, ongoing.

Supervision of Master Thesis (selection)

- **Sebastian Schlautmann**, *Quantum optimal control of the Lindblad equation with full- and low-rank exponential Euler methods*, MSc Math. Thesis, Univ. Würzburg, 2026.
- **Patrick Schurk**, *On linear and bilinear quadratic norm- and time-optimal control problems*, MSc Math. Thesis, Univ. Würzburg, 2026.
- **Natalie Vonier**, *Iterative methods for shape from shading*, MSc Math. Thesis, Univ. Würzburg, 2026.
- **Gerhard Dill**, *The Helmholtz-Kirchhoff integral equation and scattering of acoustic waves*, MSc Math. Thesis, Univ. Würzburg, 2025.
- **Simon Labisch**, *A new approach for image segmentation with LSTM cells*, MSc Math. Thesis, Univ. Würzburg, 2024.
- **Felix Michnik**, *Competitive gradient descent for multi-task learning in neural networks*, MSc Math. Thesis, Univ. Würzburg, 2024.
- **Emanuel Pfarr**, *Multigrid methods for least squares problems in tomographic image reconstruction*, MSc Math. Thesis, Univ. Würzburg, 2023.
- **Jonas Doré**, *A recurrent neural network to approximate Koopman operators with application to oscillatory systems*, MSc Math. Thesis, Univ. Würzburg, 2023.
- **Katja Lauer**, *Bildrekonstruktionseigenschaften bei modell- und datengetriebener Regularisierun zur Lösung schlecht gestellter inverser Probleme in der Magnetresonanztomographie*, MSc Math. Thesis, Univ. Würzburg, 2022.
- **Anna Rauch**, *Segmentation by weighted aggregation*, MSc Math. Thesis, Univ. Würzburg, 2021.
- **Kristina Meth**, *Parameter optimization with differential evolution of neural networks for image analysis*, MSc Math. Thesis, Univ. Würzburg, 2021.
- **Melissa Finster**, *Synchronization of Kuramoto and FitzHugh-Nagumo Networks*, MSc Math. Thesis, Univ. Würzburg, 2021.
- **Hannah Weinmann**, *Ecosystem models and social balance from a synchronization perspective*, MSc Math. Thesis, Univ. Würzburg, 2021.
- **Sarah Winkelmann**, *Optimal design with Liouville equation for optical systems*, MSc Math. Thesis, Univ. Würzburg, 2021.
- **Sebastian Hofmann**, *Sequential quadratic Hamiltonian schemes for training Runge-Kutta structured neural networks*, MSc Math. Thesis, Univ. Würzburg, 2021.
- **Max Steinlein**, *The Pontryagin maximum principle for solving Liouville optimal control problems*, MSc Math. Thesis, Univ. Würzburg, 2020.

- **Jonas Kleieisel**, *Continuous models of pulse-coupled neural networks for image segmentation*, MSc Math. Thesis, Univ. Würzburg, 2020.
- **Nico Nees**, *A FEM-SQH framework for solving elliptic optimization problems*, MSc Math. Thesis, Univ. Würzburg, 2020.
- **Andreas Seufert**, *On the SSN and SQH methods for solving non-smooth optimal control problems*, MSc Math. Thesis, Univ. Würzburg, 2020.
- **Nadja Henning (now Vater)**, *Nested iteration for approximation with neural networks*, MSc Math. Thesis, Univ. Würzburg, 2019.
- **Jan Bartsch** , *Optimal control problems governed by Liouville models - Mathematical analysis and implementation*, MSc Math. Thesis, Univ. Würzburg, 2018.
- **Melina-Loren Kienle Garrido**, *On the optimal control of a new cancer therapy model*, MSc Math. Thesis, Univ. Würzburg, 2017. (with publication in Journal)
- **Lisa Schäfer**, *A mathematical investigation of a new Lorentz-covariant heat conduction model*, MSc Math. Thesis, Univ. Würzburg, 2017.
- **Andrea Thomann**, *Stability and accuracy of a pseudospectral scheme for the Wigner function equation*, MSc Math. Thesis, Univ. Würzburg, 2015. (with publication in Journal)
- **Veronika Thalhofer**, *Formulation and investigation of a new stochastic hybrid system for subtilin production and the corresponding Fokker-Planck equation*, MSc Math. Thesis, Univ. Würzburg, 2015. (with publication in Journal)
- **Roberta Mancini**, *An adjoint-based optimization scheme for solving time-domain electromagnetic inverse scattering problems*, MSc Math. Thesis, Univ. Sannio, 2009.
- **Elisabeth Decker**, *Spectral methods for the Schrödinger equation*. MSc Math. Thesis, Univ. Graz, 2005. (with publication in Journal)

Main Research Grants

- BFHZ-BayFrance-Project **Optimal Control of Vlasov-Poisson Models** (Project Leader, 1 year; start 2025). Supported by BFHZ-BayFrance, Germany.
- BMBF-Verbundprojekt **iDeLIVER - Intelligent MR Diagnosis of the Liver by Linking Model and Data-Driven Processes** (Project Leader, 3 years), supported by BMBF, Germany.
- BFHZ Project **Multi-Agent Fokker-Planck Nash Games** (Project Leader, 1 year; start 2018). Supported by BFHZ, Germany.
- BMBF-Verbundprojekt **ROENOBIO - Robust Energy Optimization of Fermentation Processes for the Production of Biogas and Wine** (Project Leader, 4 years; start 2013), supported by BMBF, Germany.
- EU Marie-Curie **Multi-ITN STRIKE - Novel Methods in Computational Finance** (Project Leader, 3 years; start 2013). Supported by EU.
- IZKF-Project **Parallel Multigrid Imaging and Compressed Sensing for Dynamic 3D Magnetic Resonance Imaging** (Project Leader, 3 years; start 2013). Supported by IZKF Universität Würzburg, Germany.
- DFG Project **COCIQ, Controllability and Optimal Control of Interacting Quantum Dynamical Systems** (Project Leader, 3 years; start 2012). Supported by DFG, Germany.

- FWF-Project, MGINV-MOBIS, SFB Mathematical Optimization with Applications to Biomedical Sciences (while on leave in U. Benevento), **Fast Multigrid Methods for Inverse Problems** (Project Leader, 2 years; start 2008). Supported by FWF, Austria.
- FWF-Project, **Quantum Optimal Control of Semiconductor Nanostructures** (Project Leader, 3.5 years; start 2005). Supported by FWF, Austria.

Industrial Projects

- Towards the optimal control of Boltzmann models of ionized gases (with SPARC Industries SARL Luxemburg.)
- CFD Optimal shape design (with AVL List GmbH).
- PARALLEL AMG: Investigation and Development (with AVL List GmbH).
- Boundary Conditions Calculation in gas-dynamics package BOOST (with AVL List GmbH).
- The Simulation of the Gas Dynamics with Perforated Pipes in Plenum or in Pipes with BOOST (with AVL List GmbH).
- Comparison of Multigrid and SOR for the Solution of the Reynolds Equation in EXCITE (with AVL List GmbH).

Organization of Workshops/Conferences

- Organizer and Chair of the European Multigrid Conference EMG2010, Isola d'Ischia, Italy, 2010.
- European Science Foundation OPTPDE Workshop Fast solvers for simulation, inversion, and control of wave propagation problems, 26 - 28 September 2011, University of Würzburg, Germany. (ESF Grant 22.000 Eur)
- Weizmann Workshop 2013 on Multilevel Computational Methods and Optimization, The Weizmann Institute of Science, April 30 - May 02, 2013, Rehovot, Israel.
- European Science Foundation OPTPDE Workshop ESF OPTPDE Workshop InterDyn2013, 10 - 12 September 2013, Universite Paris-Dauphine , Paris, France. (ESF Grant 26.000 Eur)
- Multi-ITN STRIKE and WWCSC Mini-Workshop in Stochastic Computing and Optimization, Würzburg, Germany, September 30 - October 2, 2014
- 27th IFIP TC7 Conference 2015 on System Modelling and Optimization, Sophia Antipolis, France, 29.6. - 3.7.2015: Two Minisymposia: 1) Quantum optimal control; 2) Sparse reconstruction and medical imaging.
- FGS'2019 French-German-Swiss Conference on Optimization, Nice, Valrose campus, France, 17.9. - 20.9.2019: Minisymposium: Game theory approaches in Inverse Problems and Control.
- SIAM Conference on Optimization (OP21), Spokane, Washington, U.S., 22.07. - 23.7.2021: Minisymposium: The Passage from Optimal Control to Differential Game Problems - Part I and II.
- QuantMOCOTE - Modelling, Optimization and Control of Quantum systems in Technology and Education, Würzburg, Germany, 6-8 March 2023.
- MLSciComp - Machine Learning and Scientific Computing with Applications in Life Sciences and Engineering, Würzburg, Germany, 26-28 June 2023.

Some Invited Talks

- A geometry-aware bio-inspired sparse reservoir with online learning, Reservoir Computing Conference RCC 2026, TU Berlin, 25-26 March 2026, Germany.
- Full- and low-rank exponential Euler integrators for Lindblad quantum simulations, International School of Multiscale Mathematical Models for Multi-Agents Systems, Ettore Majorana Foundation and Centre for Scientific Culture, Erice (TP), 2-6 March 2026, Italy.
- Reservoir Computing for Scientific Modeling and Data Analysis, February 2026, Politecnico di Bari and Dip. Matematica e Informatica Università di Ferrara, Italy.
- Applications of optimal control to kinetic models, Workshop on Advances in Algorithmic Optimization, February 2026, Department of Mathematics, University of Innsbruck, Austria
- Applications of optimal control to kinetic models, Workshop on Advances in Algorithmic Optimization, November 2025, Mathematikon, Heidelberg University, Germany.
- Optimal control and machine learning, September 2025, Department of Mathematics, University of Roma II Tor Vergata, Italy.
- Preconditioned gradient methods for multi-objective optimization and games, KAUST International Research Conference on Multi-Grid and Multi-Scale Methods in Computational Science, IMG 2025, Thuwal, Kingdom of Saudi Arabia.
- Oscillatory ecosystem models and social balance from a synchronization perspective, Second Workshop on Mathematical Challenges in Ecology and Biology, February 2025, Politecnico di Bari, Italy.
- Stabilization of a linear kinetic model with collisions by a feedback-like control field, 28th International Conference on Transport Theory (ICTT-28), September 2024, University of Notre Dame Rome, Italy.
- Quantum control problems from one- to multi-particle systems, Q-ESCAPE 2024, Quantum Errors, Sensing and Control: Principles, Applications and Engineering, July 22-24, SUSTech, Shenzhen, China.
- Numerical analysis of a general kinetic Fokker-Planck equation with specular reflection boundary conditions, March 2024, Department of Mathematics and Informatics, Universita di Firenze, Italy.
- A new approach to high contrast and resolution reconstruction in quantitative photoacoustic tomography, February 2024, MOX, Department of Mathematics, Politecnico di Milano, Italy.
- A Monte Carlo approach to control and stabilization of a linear kinetic model, Nov.-Dec. 2023, Workshop on Applied Mathematics: Quantum and Classical Models (WAMQCM2023), Department of Mathematics and Informatics, Universita di Firenze, Italy.
- The Sequential Quadratic Hamiltonian Method, European Conference on Computational Optimization (EUCCO), September 2023, Heidelberg, Germany.
- Formulation and Monte Carlo solution of linear kinetic optimal control problems, September 2023, Department of Mathematics, University of Roma II Tor Vergata, Italy.
- Open and Closed-Loop Linear Kinetic Optimal Control Problems, September 2023, Department of Mathematics and Informatics, University of Catania, Italy.
- Quantum models and optimal control problems, May 2023, Simula Research Laboratory, Oslo, Norway (Online).

- Some multilevel, preconditioning, and optimal control techniques in machine learning, March 2023, International School for Advanced Studies (SISSA), Trieste, Italy.
- On multilevel, preconditioning, and optimal control techniques in machine learning, Workshop on Mathematical Data Science, Control and Optimization, Sept.-Oct. 2022, University of Graz, Austria.
- Ensemble optimal control problems governed by kinetic models, Sept. 2022, Universita' della Calabria, Cosenza, Italy.
- Exploring multilevel, preconditioning, and optimal control techniques for training neural networks, Aug. 2022, International Multigrid Conference 2022 (IMG 2022), Lugano, Switzerland.
- A journey through quantum control problems, July 2022, Centre National de la Recherche Scientifique, Institut de Physique et Chimie des Matériaux de Strasbourg, France.
- The Pontryagin maximum principle and the training of Runge-Kutta neural networks, Jan. 2022, Department of Mathematics and Physics, University of Caserta, Italy.
- The Pontryagin maximum principle and the training of Runge-Kutta neural networks, Jan. 2022, MOX Seminars Series, Department of Mathematics, Politecnico di Milano, Italy.
- The Pontryagin maximum principle and the training of Runge-Kutta neural networks, Dec. 2021, Department of Mathematics and Informatics, University of Catania, Italy.
- Super-resolution fluorescence microscopy and a mean-field Fokker-Planck equation for the reconstruction of a cell membrane potential, Nov. 2021, Facoltà di scienze informatiche, Università della Svizzera italiana, Lugano, Switzerland.
- Super-resolution fluorescence microscopy and a mean-field Fokker-Planck equation for the reconstruction of a cell membrane potential, Nov. 2021, Department of Mathematics and Informatics, University of Firenze, Italy.
- On ensemble optimal control problems with deterministic and stochastic kinetic models, SIMAI 2020+2021 Congress, Aug.-Sept. 2021, Parma, Italy.
- A new method to compute optimal relaxed controls, Minisyposium Nonsmoothness in PDE constrained optimization and variational inequalities, part of the 29th IFIP TC7 Conference on System Modelling and Optimization, Quito, Ecuador (Online)
- Super-resolution microscopy and mean-field Fokker-Planck equations for the reconstruction of cell membrane potentials, Department of Mathematics and Informatics, University of Catania, 30.07.2021, Catania, Italy.
- On solving dynamical Nash games using the Pontryagin maximum principle, SIAM Conference on Optimization (OP21), July 2021, Spokane, Washington, U.S. (Online)
- Continuity equations and super-resolution microscopy for the reconstruction of a cell membrane potential, Lomonosov State University and the Institute of Numerical Mathematics (INM) at the Steklov Institute of Mathematics, April 2021, Moscow, Russia. (Online)
- The sequential quadratic Hamiltonian scheme solving challenging optimal control problems, MODEMAT, Escuela Politécnica Nacional, October 2020, Quito, Ecuador. (Online)
- The Liouville equation, its extensions, and related optimal control problems, October 2020, Universität Basel, Switzerland. (Online)
- On ensemble optimal control problems governed by Liouville, Fokker-Planck and linear Boltzmann equations - A workshop to celebrate the 50th anniversary of applied mathematics at the FAU Erlangen Nürnberg, March 2020, Germany.

- A sequential quadratic Hamiltonian scheme for solving optimal control problems with non-smooth cost functionals, Workshop “New trends in PDE constrained optimization”, October 2019, RICAM, Linz, Austria.
- Optimal control problems with random and stochastic models, Autumn School 2019, DFG Research Training Group 2126 - Algorithmic Optimization -, University of Trier, October 2019, Trier, Germany.
- Optimal control of the Keilson-Storer master equation, Department of Mathematics and Informatics, University of Catania, 02.09.2019, Catania, Italy.
- On differential games with bilinear structure - a general framework for modelling pedestrians' motion -, Minisymposium “Novel Concepts in Model-driven Optimization and Control of Agent-based Systems”, ICIAM 2019, 15.07-19.07.2019, Universidad de Valencia, Spain.
- Zufall und Spiele beim Spaziergehen, Kinderuni Weil der Stadt, 16.05.2019, Weil der Stadt, Germany.
- On the modelling of particle and pedestrian motion with Fokker-Planck equations, MOX Seminars Series, Department of Mathematics, Politecnico di Milano, April 2019, Milano, Italy.
- On the modelling of particle and pedestrian motion with Fokker-Planck equations, Department of Mathematics, Imperial College London, February 2019, London, UK.
- On the optimal control of a Kohn-Sham quantum model, Workshop PRACQSYS 2018: Principles and Applications of Control in Quantum Systems, Henri Poincarè Institute, July 2018, Paris, France.
- From Brownian to pedestrian motion and Fokker-Planck Nash games, Lothar-Collatz-Kolloquium für Angewandte Mathematik, Fachbereich Mathematik, Universität Hamburg, June 2018, Hamburg, Germany.
- From Brownian to pedestrian motion and Fokker-Planck Nash games, Lomonosov State University, April 2018, Moscow, Russia.
- From Brownian motion to pedestrian avoidance, Mathematisches und Mathematik-didaktisches Kolloquium, Universität Oldenburg, November 2017, Oldenburg, Germany.
- On the solution of some PDE control problems in the framework of the Pontryagin' s maximum principle, Workshop INDAM 'Numerical methods for optimal control problems: algorithms, analysis and applications', June 2017, Rome, Italy.
- On a Fokker-Planck Nash game to model pedestrian motion, Schwerpunktskolloquium, University of Konstanz, October 2017, Germany.
- Fast iterative schemes for solving PDE control problems with the Pontryagin maximum principle, Institute of Numerical Mathematics (INM) at the Steklov Institute of Mathematics, February 2017, Moscow, Russia.
- Analysis of a pseudospectral scheme for the Wigner function equation, Workshop Mathematical Models for Quantum and Classical Mechanics, SEMODAY 2016, Nov. 17-18, 2016, Florence, Italy.
- Optimal control and function identification in the wine fermentation process, Kolloquium der Mathematik, Fakultät fuer Mathematik, Physik und Informatik der Universität Bayreuth, Oct. 2016, Germany.
- On a time-dependent Kohn-Sham equation and related optimal control problems, CECAM Workshop Numerical methods for optimal control of open quantum systems, Sept. 26-28, 2016, FU Berlin, Berlin, Germany.

- Advances in the numerical solution of quantum control problems, Workshop Quantum Cybernetics & Control 2015 (QCC2015), Jan. 19-23, 2015, Nottingham, UK.
- A Fokker-Planck strategy to control stochastic processes, Marian Smoluchowski Symposium on Statistical Physics, Sept. 22-26, 2014, Zakopane, Poland.
- A Fokker-Planck Strategy to Control Stochastic Processes, Kolloquium, 2014 April, Johann Radon Institute for Computational and Applied Mathematics (RICAM), Austrian Academy of Sciences, Linz, Austria.
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- A Fokker-Planck-Kolmogorov control framework for stochastic processes, Workshop Numerical Methods for Uncertainty Quantification, May 13-17, 2013, Hausdorff Center for Mathematics, Bonn, Germany.
- An Optimal Control Strategy for Probability Density Functions of Stochastic Processes and Piecewise Deterministic Processes, Mathematisches Kolloquium, Univ. Bayreuth, Jan. 2013, Germany.

Scientific Outreach

Interviews in national newspapers

- Süddeutsche Zeitung, Section 'Panorama', 11. Oktober 2017, Nr. 234: **Alfio Borzì, der ein mathematisches Modell gegen Zusammenstösse entwickelt hat**; see also http://www.sueddeutsche.de/panorama/ein-anruf-bei-alfio-borz-1.3702529
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- Bayerische Rundfunk Fernsehen, Frankenschau aktuell Das Wichtigste aus Franken, 14. März 2018: **Pi-Tag**; see also https://www.br.de/mediathek/video/frankenschau-aktuel 5a71a5a08e1343001858eb4c and https://youtu.be/6B6R9SUPgIA
- SWR1 'Leute', 12.07.2018. https://www.swr.de/swr1/bw/programm/leute/borzi-prof/-/id=1895042/did=21937368/nid=1895042/o1p3rc/index.html

Youtube Videos

- **Alfio's Math** : https://www.youtube.com/watch?v=ju6rG_7Z_5I
- **Quantenmechanik - Von Democritus bis Schrödinger** : https://www.youtube.com/watch?v=BTiPcnT_QKc
- **Quantenkontrolle - Die Zukunft der Wissenschaft!** : https://www.youtube.com/watch?v=OOKMy9OzXuM
- **Malthus & Verhulst, die Bevölkerungsentwicklung und die Weingärung** : https://www.youtube.com/watch?v=NtLnp1cUPmc
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- **On the optimal control of a Kohn-Sham quantum model - Workshop PRACQSYS 2018 at IHP Paris** : https://www.youtube.com/watch?v=6chQrO2uInY&index=53&list=PL9kd4mpdvWcAMYt4Fhw0dgBPF24bQmDGz

Popularising Lectures and Books

- **Wissenschaftliches Rechnen am Beispiel der Weingärungs**, Marktbreit, 08.10.2014. (A lecture for the Winemakers Community on the modelling and efficient control of wine fermentation.)

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- **New Trends in Mathematics**, Staats- und Universitätsbibliothek der Universität Göttingen, 16.10.2015. (A lecture for Teachers on present research developments and trends in applied mathematics.)
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- **Falling Into A Well While Gazing At The Stars - A Very Short History of Mathematics -**. (A children book giving a short account of the early history of mathematics.)

Alfio Borzì 's Publications

Books

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- A. Borzì, G. Ciaramella and M. Sprengel, **Formulation and Numerical Solution of Quantum Control Problems**, SIAM, Philadelphia, 2017 (ISBN 978-1-611974-83-6).
- A. Borzì and V. Schulz, **Computational Optimization of Systems Governed by Partial Differential Equations**, SIAM, Philadelphia, 2012 (ISBN 978-1-611972-04-7).
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Algorithms

- **MOCOKI**: A Monte Carlo approach for optimal control in the force of a linear kinetic model (2021); in Computer Physics Communications, CPC Program Library.
- **COKOSNUT**: A code for the control of the time-dependent Kohn-Sham model (2017); in Computer Physics Communications, CPC Program Library.
- **LONE**: A code for the sparse control of quantum systems (2016); in Computer Physics Communications, CPC Program Library.

- **SKRYN**: A fast semismooth-Krylov-Newton method for controlling Ising spin systems (2015); in Computer Physics Communications, CPC Program Library.
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- **CNMS**: a cascadic monotonic time-discretized algorithm for finite-level quantum control computation (2008); in Computer Physics Communications, CPC Program Library.
- **SANTAFE**: a space-time multigrid method for open-loop (and receding-horizon) optimal control of time-dependent reaction-diffusion systems (2005). In MGNet Home Page, http://www.mgnet.org.
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- **INTEGRA**: a multigrid code for the solution of systems of nonlinear integral equations (1998). In MGNet Home Page, http://www.mgnet.org.
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- H. Chen, A. Borzì, D. Janković, J.-G. Hartmann, and P.-A. Hervieux, **Full- and low-rank exponential euler integrators for the Lindblad equation**, SIAM Journal on Scientific Computing, 48(1), 2026. https://doi.org/10.1137/24M1690795
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